April 22, 1952 C. J. COBERLY 2,593,729

CLOSED SYSTEM HYDRAULIC PUMP

Filed July 1, 1946 3 Sheets-Sheet 1

Fig. 1

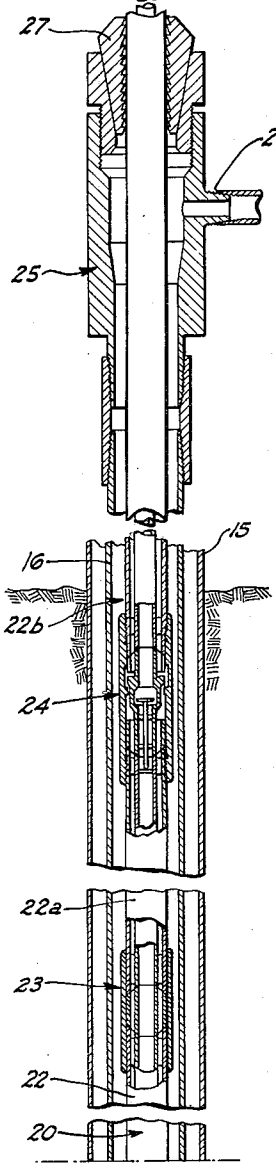


Fig. 3

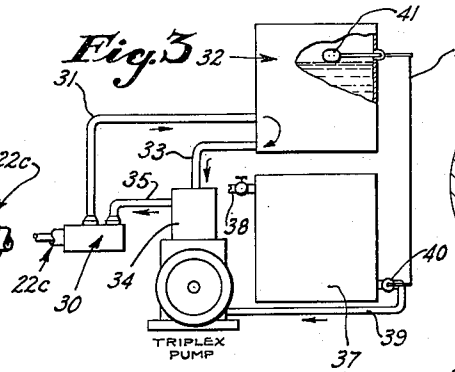


Fig. 2

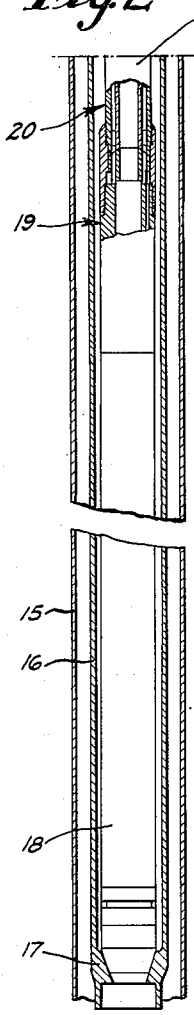
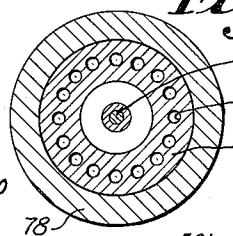


Fig. 5



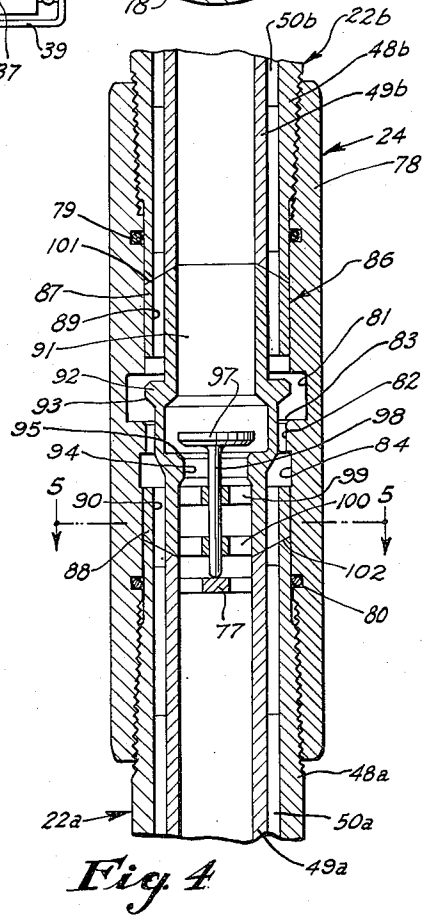


Fig. 4

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CLOSED SYSTEM HYDRAULIC PUMP

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Fig. 6

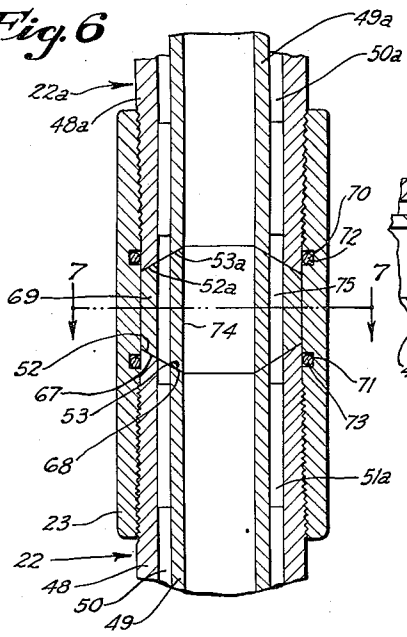
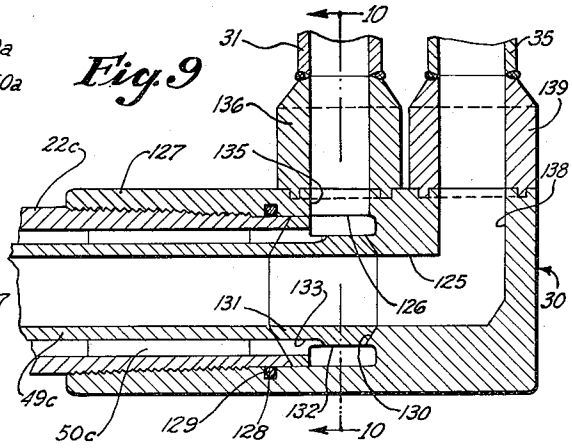


Fig. 9



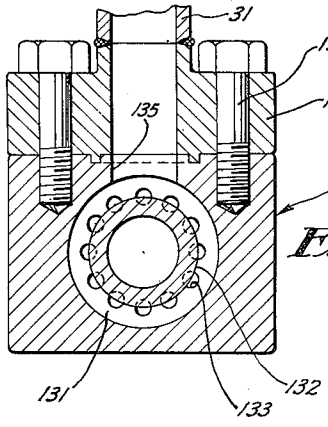


Fig. 10

Fig. 7

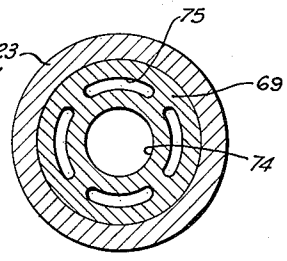
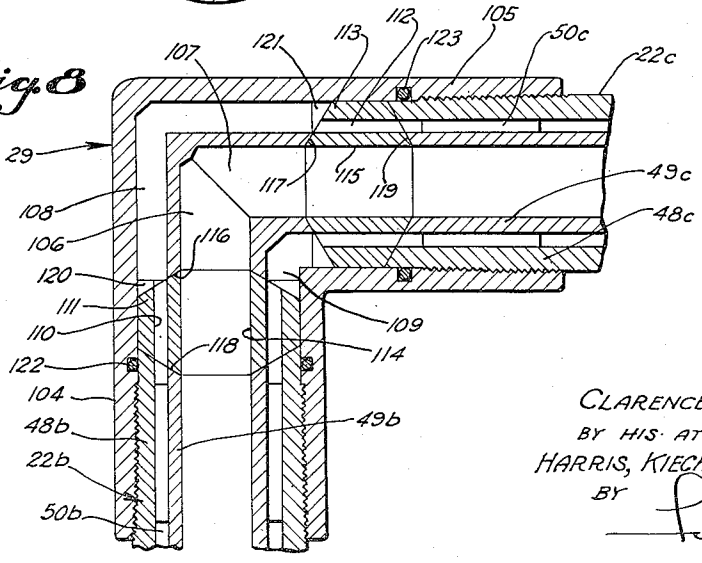


Fig. 8



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CLOSED SYSTEM HYDRAULIC PUMP

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Fig. 11

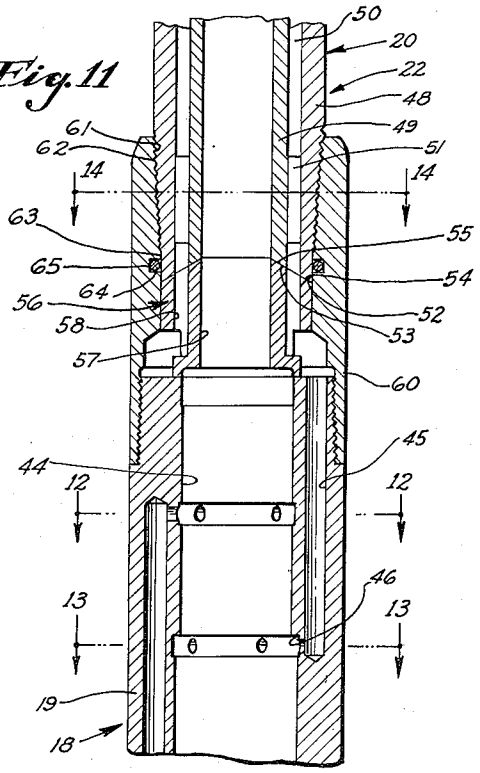


Fig. 12

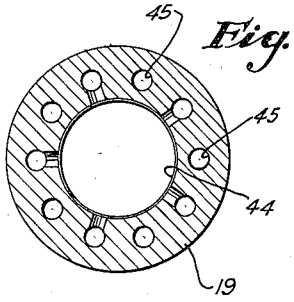


Fig. 13

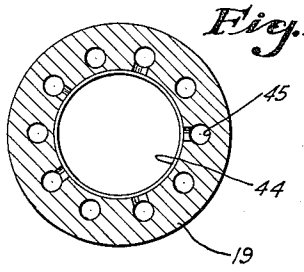
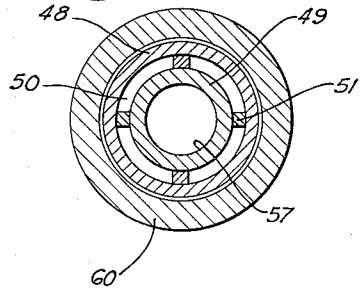


Fig. 14



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UNITED STATES PATENT OFFICE

2,593,729

CLOSED SYSTEM HYDRAULIC PUMP

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Application July 1, 1946, Serial No. 680,679

8 Claims. (Cl. 103—46)

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This invention relates to fluid operated well pumps, and more particularly, to a closed system of supplying operating fluid to such a pump.

In conventional fluid operated well pumps, operating fluid is supplied thereto under relatively high pressure through a power tubing extending downwardly in the well. As is well known in the art, such operating fluid is alternatively directed by a suitable valve in the pump mechanism to opposite ends of a motor piston which is coupled by a suitable piston rod to the piston of a displacement pump. By such application of operating fluid to the power piston it, and consequently the pump piston, is reciprocated to pump well fluid from the well, such well fluid normally being conveyed upwardly to the ground surface by a production tubing. In such a pump it is conventional practice to discharge the spent operating fluid from the motor cylinder into the column of pumped well fluid so that they are intermixed and conveyed upwardly together through the production tubing. As the operating fluid supplied to the pump must be clean, to prevent abrasion of the moving parts, fresh clean operating fluid must be continuously supplied to the system. The continuous provision of such fresh operating fluid requires considerable equipment, normally in the form of settling tanks or filters, all of which is expensive.

It is therefore a primary object of this invention to provide a separate closed system for such operating fluid, so that instead of mixing it with the well production as mentioned above, it is separately conveyed back to the surface of the ground for storage and re-use to actuate the fluid operated pump. With such a closed system there is relatively little loss of operating fluid therefrom, and, consequently, the equipment provided to supply fresh, clean operating fluid to the system need have only a relatively small capacity and can be relatively cheap and economical. Further objects of the invention, of course, reside in certain required modifications of the pump, and in the well tubing employed to provide such a closed system.

In the conventional operation of a fluid-operated pump a high pressure oil pump, usually of the triplex type, is employed on the ground surface to convey the operating fluid under high pressure to the well pump. The specific construction of such a triplex pump is well known in the art and forms no part of the present invention. However, it is important to note that such triplex pumps are normally equipped with an auxiliary scavenger pump of small capacity which adds back into the system on the intake side of the triplex all leakage therefrom which is separately collected.

It is a further object of this invention to employ such scavenger pump to replenish to such

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a closed operating fluid system as described such additional operating fluid as may be required due to leakage in the well pump or power tubing. To accomplish this, I provide a reservoir of operating fluid which is connected to the scavenger pump by a valved line so that by opening the valve the scavenger pump can add fluid from the reservoir to the closed system as desired, and this is an additional object of the invention.

It is a further object of the invention to provide such a closed system in which the fluid reservoir is operatively connected to the scavenger pump in response to a reduction of the total volume of fluid in the closed system, due to leakage therefrom or otherwise. I prefer to accomplish this by providing a collection tank connected to the intake of the triplex pump, into which tank the spent operating fluid from the well discharges, and to provide float means in such tank which moves in response to a change in the total volume of operating fluid in the closed system to control the valve between the reservoir and the scavenger pump. By such a combination, at any time that the total volume of operating fluid in the closed system falls below a predetermined minimum, such valve is opened to permit the scavenger pump to draw additional operating fluid from the reservoir and to introduce it into the closed system until the total volume of operating fluid in the system has been increased by a predetermined amount, at which time the float means closes the valve. These features of construction are additional objects of the invention.

Still another object of the invention is to provide a double-walled well tubing in which the inner and outer walls are spaced but rigidly joined together so that they may be easily handled as a joint or section assembly.

Another object of the invention is to provide a coupling for such double-walled tubing joints, such as to form fluid-tight couplings between the inner and outer tubings, respectively, of adjacent joints of the tubing.

A further object of my invention is to supply a coupling for stands of such double-walled tubing such as to form such fluid-tight couplings and further so as to retain in each stand of the tubing, as it is broken from the stand below, any operating fluid contained therein. This prevents loss of such operating fluid and avoids what is known in the industry as a "wet pulling job" as the tubing is withdrawn from the well. I prefer to accomplish this by providing suitable valves in each coupling such as to close both the inner and outer tubings as the coupling is broken, which is also an object of the invention.

Other objects and advantages will appear from the following specification and the draw-

ings, which are for the purpose of illustration only, and in which:

Fig. 1 is a vertical view, partly in section, of the upper end of my well equipment installed in a well;

Fig. 2 is a downward continuation of Fig. 1, showing the lower end of my equipment installed in the well;

Fig. 3 is a diagrammatic view of the surface equipment, reduced in size relative to the scale of Figs. 1 and 2;

Fig. 4 is an enlarged vertical section view of the standing coupling of my invention;

Fig. 5 is a cross-sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is an enlarged vertical sectional view of the tubing coupling of my invention;

Fig. 7 is a cross-sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is an enlarged longitudinal sectional view taken through the special elbow-type coupling of the invention;

Fig. 9 is an enlarged longitudinal sectional view taken through a special separation fitting of the invention;

Fig. 10 is a cross-sectional view taken on the line 10—10 of Fig. 9;

Fig. 11 is an enlarged vertical sectional view taken through the upper end of my modified form of fluid operated well pump, showing the double-walled tubing connected thereto;

Fig. 12 is a cross-sectional view taken on the line 12—12 of Fig. 11;

Fig. 13 is a cross-sectional view taken on the line 13—13 of Fig. 11; and

Fig. 14 is a cross-sectional view taken on the line 14—14 of Fig. 11.

Referring to Figs. 1 and 2, the drawings show a conventional well casing 15 set in a well, and having a production tubing 16 extending downwardly thereinto, the lower end of the production tubing being provided with a pump seat 17 on which is seated a fluid operated pump 18. To the upper end of the pump 18 is affixed a special inlet fitting 19 by which the pump is connected to power tubing 20, which extends upwardly through the production tubing.

The power tubing 20 is formed of a plurality of axially aligned tubing sections 22, 22*a*, and 22*b*, commonly referred to in the oil industry as tubing joints. For convenience of description, only three of such tubing sections are shown, the tubing sections 22 and 22*a* being connected together by a tubing coupling 23, and the tubing sections 22*a* and 22*b* being connected together by a valved coupling 24. It will be understood by those familiar with the oil industry, however, that the power tubing 20 in actual practice is normally made up of a large number of such tubing sections which are divided into stands of tubing, each stand comprising three or four tubing sections, and a valved coupling like the valved coupling 24 is provided at the lower end of each stand. The remaining tubing sections in each of the stands are connected together by tubing couplings like the tubing coupling 23. The tubing sections 22, 22*a*, and 22*b* are generally similar in construction, and parts of the sections 22*a* and 22*b* which are similar to parts of the section 22 will be referred to by similar numerals as refer to the parts of the tubing section 22, but with the suffixes *a* and *b* added thereto respectively.

The upper end of the production tubing 16 is coupled in a conventional manner to a standard casing head 25 which is provided with a discharge nipple 26 disposed so as to convey pumped well fluid from the production tubing to a point of disposal or use (not shown). The upper end of the casing head 25 may be provided with conventional slips 27, if desired, to additionally support the power tubing. Connected to the upper end of the vertical portion of the power tubing 20 is a special elbow fitting 29, which directs the power tubing horizontally therefrom to a separation fitting 30, shown in Fig. 3. To the separation fitting 30 is connected a spent power fluid line 31 which is adapted to convey spent power fluid from the fitting 30 to a collection tank 32 which is connected at its bottom by means of a flow line 33 to a high pressure pump 34, preferably of the triplex type, which is adapted to convey power fluid from the collection tank to the separation fitting 30 by a discharge line 35. As will be understood, the pump 34 is disposed on the surface of the ground, and may be of any type desired which is adapted to supply power fluid to the line 35 under pressure sufficient to operate the fluid operated pump 18, as is generally well known in the art. As will also be noted in the embodiment illustrated the collection tank 32 is disposed substantially above the pump 34 so that power fluid can flow by gravity under some inlet pressure from the collection tank to the pump. Obviously, means other than gravity may be provided for this purpose if desired. Also provided above the surface of the ground is an auxiliary tank 37 which constitutes a source of additional power fluid, being supplied therewith as may be required through a valved inlet pipe 38. The high pressure pump 34, as is well known in the art, is provided with an auxiliary pumping means (not shown) which is adapted to return to the intake of the high pressure pump communicating with the flow line 33 any leakage that may occur in the pump. The auxiliary tank 37 is connected to the intake of such auxiliary pump by a fluid line 39, so that when the fluid line is open the auxiliary pump may draw additional operating fluid from the auxiliary tank 37 and convey it to the intake of the high pressure pump 34, so as to replenish operating fluid lost from the power tubing 20 and fluid operated pump 18 during normal operation thereof. A float-actuated valve 40 is provided in the fluid line 39 and is operated by a conventional float mechanism 41 disposed in the collection tank 32, the valve 40 and the float mechanism being mechanically connected by a suitable rod 42. As will be understood, when the total volume of operating fluid in the power tubing 20 decreases, due to leakage or other causes, the level thereof in the collection tank 32 will drop, and when the volume is reduced to a predetermined value the float mechanism 41 acting through the rod 42 will operate the float-actuated valve 40 to admit additional operating fluid from the auxiliary tank 37 to the auxiliary pump of the high pressure pump 34 through the fluid line 39, to replenish such fluid lost from the power tubing. When the fluid level in the collection tank 32 rises to a predetermined extent, the float mechanism 41 will operate through the rod 42 to close the valve 40. This mechanism, thus, automatically replenishes operating fluid lost from the power tubing 20 as may be required during operating of the fluid operated pump 18.

Referring to Fig. 11, the fluid operated pump 18 is provided with the inlet fitting 19 at its upper end, having a central bore 44 adapted to receive operating fluid from the power tubing 20 and to

convey it to the fluid operated pump to actuate the same. The inlet fitting 19 is also provided with a plurality of circumferentially spaced longitudinal passages 45 which communicate with the upper end of the fitting and with an annular groove 46 formed in the bore of the fitting. As will be understood by those skilled in the art, the annular groove 46 is adapted to cooperate through suitable valve mechanism (not shown) to convey spent operating fluid from the motor cylinder of the fluid operated pump 18 to the longitudinal passages 45 so that the same may be discharged upwardly therethrough and into the power tubing 20.

As shown in Fig. 11, the lowermost tubing section 22 includes an outer tubing member 48 and an inner tubing member 49 concentrically disposed within the outer tubing member and spaced therefrom so as to provide an annular longitudinal space 50. The outer and inner tubing members 48 and 49 respectively, are rigidly retained in spaced relation, as shown, by two or more spacer bars 51 disposed therebetween and welded or otherwise rigidly secured to the tubing members. Also, as shown in Fig. 11, the lower ends of the tubing members 48 and 49 are provided with conical seating faces 52 and 53, respectively, which are adapted to seat on and respectively form fluid-tight engagement with conical seats 54 and 55, provided on the upper end of an insert member 56. The insert member 56 is provided with a central bore 57 which is axially aligned with the inner tubing member 49 and with the central bore 44 of the inlet fitting 19 so as to provide fluid communication therebetween. The insert member 56 also has a plurality of circumferentially spaced longitudinal passages 58 which provide fluid communication between the annular longitudinal space 50 of the power tubing 20 and the longitudinal passages 45 of the inlet fitting 19. The upper end of the inlet fitting 19 is provided with external threads adapted to receive internal threads of a coupling member 60, the upper end of which is internally threaded at 61 onto external threads 62 formed on the outer tubing member 48. It is to be noted that the outer tubing member 48 is provided with a straight tubular portion 63 below the threads 62, which portion is adapted to engage an annular resilient O-ring 64 carried in an annular groove 65 in the coupling member 60, so as to form a fluid-tight seal between the coupling member and the outer tubing member.

As shown in Fig. 6, the upper end of the tubing section 22 is identical in construction with the lower end, just described, but is reversed in position, providing conical seating faces 52 and 53 on the outer and inner tubing members 48 and 49, respectively, which seating faces engage in fluid-tight relation with mating conical seats 67 and 68, respectively, formed on an insert member 69. The insert member 69 is provided at its upper end with similar conical seats, which similarly engage conical seating faces 52*a* and 53*a* formed on the lower end of the next succeeding tubing section 22*a*. The tubing sections 22 and 22*a*, with the insert member 69 therebetween, in the position illustrated in Fig. 6, are adapted to be rigidly clamped together by the tubing coupling 23 which is threaded to the outer tubing member 48 of the tubing section 22 and to the outer tubing member 48*a* of the tubing section 22*a*. The coupling 23 is provided with a pair of spaced annular grooves 70 and 71, containing resilient O-rings 72 and 73, respectively, which engage in fluid-tight relation to the lower and upper ends of the tubing sections 22*a* and 22, respectively. The insert member 69 is provided with a central bore 74 which is axially aligned with the bores of the inner tubing members 49 and 49*a* so as to provide fluid communication therebetween, and is provided with circumferentially spaced longitudinal passages 75 which provide fluid communication between the annular space 50 and the annular space 50*a*. As will also be noted, the upper end of the tubing section 22 is also provided with spacer bars 51*a*, which are similar to the spacer bars 51 shown in Figs. 11 and 14, and the tubing section 22*a* is similarly provided with spacer bars at each of the ends thereof.

As best shown in Fig. 4, the tubing sections 22*a* and 22*b* are rigidly connected together by the valved coupling 24. The tubing sections 22, 22*a*, and 22*b* have substantially identical constructions, with the execption that the upper end of the tubing section 22*a* is provided with a transverse valve-actuating bar 77 welded or otherwise secured in the inner tubing member 49*a* thereof for a purpose to be described hereinafter. The valved coupling 24 includes an outer tubular coupling member 78 which is generally similar to the tubular coupling 23 but is somewhat longer, similarly being provided with annular O-rings 79 and 80 adapted to form fluid-tight seals with the lower and upper ends of the tubing sections 22*b* and 22*a*, respectively. Also, the central part of the coupling member 78 is provided with an annular channel 81 and an inwardly projecting annular shoulder 82 providing an outer valve seat 83. As will be noted, the shoulder 82 projects into the bore 84 of the coupling member 78.

Housed within the outer tubular coupling member 78 is a valve assembly 86 provided with upper and lower heads 87 and 88, respectively, the upper head having a plurality of circumferentially spaced longitudinal passages 89 adapted to communicate with the annular space 50*b* of the tubing section 22*b*, and the lower head 88 being similarly provided with a plurality of longitudinal passages 90 adapted to communicate with the annular space 50*a* of the tubing section 22*a*. As illustrated, the valve assembly 86 is generally tubular in form, providing a central longitudinal passage 91 therethrough and having an external annular projection 92 providing an outer conical valve face 93 adapted to seat on the outer valve seat 83, and having an inner annular projection 94 providing an inner annular valve seat 95. Adapted to seat on the inner annular valve seat 95 is an inner valve member 97, of the poppet type, having a valve stem 98 supported for vertical movement relative to the inner valve seat 95 by crossbars 99 and 100 secured in or formed integrally with the valve assembly 86. The valve assembly 86 is also provided at its upper and lower ends with seating faces 101 and 102, respectively, which are adapted to be engaged by the lower end of the tubing sections 22*b* and the upper end of the tubing section 22*a*, respectively, in fluid-tight engagement. The operation of the valve coupling 24 will be described hereinafter.

Referring to Fig. 8 of the drawings, the elbow fitting 29 includes a vertical tubular portion 104 which is adapted to threadedly receive the upper end of the outer tubing member 48*b* of the tubing section 22*b*, and is provided with a horizontal tubular portion 105 adapted to threadedly

receive one end of a tubing section 22c. The elbow fitting is provided with central bores 106 and 107 which intersect to form a central passage therethrough, and is provided with drilled passages 108 and 109 which communicates through drill ports 110 of an insert member 111 with the annular longitudinal space 50b of the tubing section 22b. The passages 108 and 109 also communicate through ports 112 of an insert member 113 with an annular longitudinal space 50c of the horizontal tubing section 22c. Similarly, the central bore 106 communicates through a bore 114 in the insert member 111 with the bore of the inner tubing member 49b, and the central bore 107 communicates through a bore 115 of the insert member 113 with the bore of the inner tubular member 49c of the horizontal tubing section 22c. The elbow fitting 29 is provided with conical seats 116 and 117 against which the insert members 111 and 113, respectively, seat to form fluid-tight engagement with the elbow fitting. Similarly, the insert members 111 and 113 seat against conical seats 118 and 119 of the inner tubing members 49b and 49c, respectively, to form fluid-tight engagement therewith. In this form of construction, however, the elbow fitting 29 is cut away at 120 and 121 so that no fluid-tight fit is made between the insert members 111 and 113 and the outer tubing members 48b and 48c, respectively, the seal between such outer tubing members and the elbow fitting being provided by O-rings 122 and 123. As will be understood, the elbow fitting 29 secures the tubing sections 22b and 22c together so as to provide a pair of fluid paths therebetween.

Referring to Figs. 9 and 10 of the drawings, the separation fitting 30 provides a connection between the horizontal tubing section 22c and the spent power fluid line 31 and the discharge line 35. The fitting 30 is provided with a central bore 125 and a counterbore 126 providing an internally threaded tubular extension 127 adapted to fittedly receive the end of the horizontal tubing section 22c. Provided in the tubular extension 127 is an annular groove 128 containing an O-ring 129 adapted to form a fluid-tight seal between the periphery of the tubing section 22c and the fitting 30. Between the bore 125 and the counterbore 126 is a conical seat 130 against which an insert member 131 seats in fluid-tight relation. The insert member 131 is provided with an annular cut-away portion 132 and with circumferentially spaced longitudinal ports 133 which communicate with the annular longitudinal space 50c of the tubing section 22c. The cut-away portion 132 also communicates through a radial port 135 with a fitting 136 welded or otherwise secured to the end of the spent power fluid line 31 and detachably connected to the separation fitting 30, as by screws 137. The central bore 125 likewise communicates through a radial port 138 with a fitting 139, similar to the fitting 136, and welded or otherwise secured to the end of the discharge line 35.

In operation, as will be understood, the power tubing 20 is first filled with operating fluid. This may be accomplished by manually opening the valve in the inlet pipe 38 and the float actuated valve 40 so that operation of the high pressure pump 34 can introduce operating fluid through the discharge line 35 and the separation fitting 30 to the power tubing. As will be understood from Fig. 9, such operating fluid, under substantial pressure, passes into the separation fitting 30 from the discharge line 35, through the insert member 131, and into the inner tubing member 49c of the tubing section 22c, from whence it continues through the elbow fitting 29 and downwardly through the inner tubing members of the power tubing 20 to the inlet fitting 19 of the fluid operated pump 18. Such operating fluid under pressure is used, as is well known in the art, to actuate the fluid operated pump 18, and subsequently is conveyed as spent operative fluid at relatively low pressure upwardly through the longitudinal passages 45 of the inlet fitting 19 to enter the annular longitudinal space 50 of the power tubing 20, through which it is conveyed upwardly through the various fittings and couplings to the separation fitting 30, outwardly through the radial port 135 thereof into the spent power fluid line 31 from which it flows to the collection tank 32. This operation is continued until the collection tank 32 is substantially filled with operating fluid, at which time the float mechanism 41, operating through the rod 42, closes the float-actuated valve 40. The high pressure pump 34 henceforth merely circulates the operating fluid from the collection tank 32 through the power tubing 20 and the fluid operated pump 18. Leakage of operating fluid from the closed system of the power tubing, fluid operated pump 18, and collection tank 32, is replenished as described above. As normal leakage in the closed operating fluid system normally does not amount to as much as 1% of the displacement of the fluid operated pump 18, the auxiliary tank 37 need have only a small volumetric capacity, and the scavenger pump operated by the high pressure pump 34, likewise, need have only a relatively small flow capacity to replenish the closed system with operating fluid as needed.

When it is desired to remove, or "pull", the power tubing 20 from the well, it is desirable, frequently, that little of the power fluid contained therein be discharged into the production tubing 16. This may readily be accomplished with the special power tubing 20, illustrated, due to the provision of the valve coupling 24. The connection between the tubing sections 22b and 22c is first broken, at the elbow fitting 29, and then the power tubing 20 is raised until the slips 27 engage the tubing section 22a just below the valve coupling 24. The tubing section 22a is then retained stationary by the slips 27, and the power tubing section thereabove is rotated together with the valve coupling 24 so as to unscrew the outer tubular coupling member 78 from the upper end of the tubing section 22a. As the coupling member 78 is unscrewed from the tubing section 22a it moves upwardly relative thereto, the valve assembly 86 remaining seated, temporarily, on the upper end of the tubing section 22a. Such upward movement of the coupling member 78 is continued until the valve assembly 86 seats on the coupling member, the outer conical valve face 93 seating on the outer valve seat 83 in fluid-tight engagement so that upon subsequent upward movement of the coupling member 78 power fluid in the annular space 50b and thereabove in the power tubing will be retained therein. During such subsequent upward movement of the coupling member 78, as will be apparent, the valve assembly 86 is also raised therewith so as to break the engagement of the valve assembly with the upper end of the tubing section 22a. Continued upward movement of the valve assembly 86 causes the inner annular valve seat

95 to engage the inner valve member 97 in fluid-tight engagement, which retains thereabove in the power tubing 20 any operating fluid contained in the inner tubing section 49b. After the inner valve member is thus closed, continued upward movement of the coupling member 78 breaks the connection between the O-ring 80 and the upper end of the outer tubing member 48a which, up to that time, has maintained a fluid-tight seal between the coupling member and the tubing section 22a, and the coupling member is then disengaged from the tubing section 22a therebelow. Thus, substantially all operating fluid in the tubing section 22b is retained therein by the valve coupling 24, and the tubing section 22b and any tubing sections thereabove connected thereto may be stacked in the vicinity of the well in a vertical position without losing any of the power fluid therefrom.

When the power tubing 20 is reassembled so as to run the fluid operated pump 18 back into the well, the operation is reversed, as will be understood. In this operation, obviously, the outer tubing coupling member 78 is moved down over the upper end of the tubing section 22a until the O-ring 80 forms a fluid-tight seal therebetween. Upon continued lowering of the coupling member 78, the valve actuating bar 77 engages the lower end of the valve stem 98 to move the inner valve member 97 off its seat 95 so as to again open communication between the inner tubing members 49a and 49b. Continued downward movement of the coupling member 78 permits the valve assembly 86 to seat on the upper end of the tubing section 22a and to break connection between the conical valve face 93 of the valve assembly and the valve seat 83, so as to reopen communication between the annular spaces 50a and 50b. The coupling member 78 is then further screwed onto the tubing section 22a until its seating faces 101 and 102 form fluid-tight engagement with the lower end of the tubing section 22b and the upper end of the tubing section 22a, respectively, so that sealing is not entirely dependent upon the O-rings 79 and 80.

It will be apparent from the foregoing that I have provided a closed operating fluid system for a fluid operated pump having the advantages and fulfilling the objects set forth above, and, further, that I have provided a special type of power tubing and fittings therefor particularly adapted for use in such a closed operating fluid system. Although I have shown and described a preferred embodiment of the invention, it will be apparent that modification thereof may be made without departing from the spirit of the invention, and, consequently, I do not intend to be limited to the specific form illustrated, but desire to be afforded the full scope of the following claims.

I claim as my invention:

1. In a fluid operated pump system, the combination of: a fluid operated pump in a well and having an inlet for operating fluid under pressure and an outlet for spent operating fluid, said pump being adapted to be actuated by the delivery thereto of operating fluid under pressure; a production tubing extending downwardly in said well so as to receive pumped well fluid from said pump and to convey it upwardly; a power tubing extending downwardly through said production tubing and connected to said pump, said power tubing including an inner tubing member and an outer tubing member radially spaced from said inner tubing member, one of said tubing members communicating with said inlet and being adapted to convey said operating fluid under pressure downwardly to said pump, and the other of said tubing members communicating with said outlet and being adapted to convey spent operating fluid upwardly from said pump, said power tubing comprising a plurality of axially aligned sections each of which includes a section of the inner tubing member and a section of the outer tubing member rigidly connected together in radially spaced relation; power pumping means connected to said one of said tubing members for supplying said operating fluid under pressure unidirectionally to said one of said tubing members only; reservoir means connected to said other of said tubing members for receiving spent operating fluid therefrom; and fluid-conducting means connecting said power pumping means to said reservoir means.

2. In a fluid operated pump system, the combination of: a fluid operated pump in a well and adapted to be actuated by the delivery thereto of operating fluid under pressure; a production tubing extending downwardly in said well so as to receive pumped well fluid from said pump and to convey it upwardly; a power tubing extending downwardly in said well and connected to said pump and including a pair of tubing members, one of said tubing members being adapted to convey said operating fluid under pressure downwardly to said pump and the other of said tubing members being adapted to convey spent operating fluid upwardly therethrough from said pump; power means for supplying said operating fluid under pressure to said one of said tubing members; collecting means connected to said other of said tubing members and adapted to receive therefrom spent operating fluid, said collecting means being also connected to said power means so as to supply operating fluid thereto; a source of additional operating fluid; and means for introducing additional operating fluid from said source into the intake of said power means to replenish operating fluid lost from the system, the means last defined including valve means interposed between said source and the intake of said power means, and including float means responsive to a predetermined reduction in fluid level in said collecting means for actuating said valve means.

3. In a fluid operated pump system, the combination of: a fluid operated pump in a well and adapted to be actuated by the delivery thereto of operating fluid under pressure; a production tubing extending downwardly in said well so as to receive pumped well fluid from said pump and to convey it upwardly; a power tubing extending downwardly in said well and connected to said pump and including a pair of tubing members, one of said tubing members being adapted to convey said operating fluid under pressure downwardly to said pump and the other of said tubing members being adapted to convey spent operating fluid upwardly therethrough from said pump; power means for supplying said operating fluid under pressure to said one of said tubing members; collecting means connected to said other of said tubing members and adapted to receive therefrom spent operating fluid, said collecting means being also connected to said power means so as to supply operating fluid thereto; a source of additional operating fluid; and means for introducing additional operating fluid from said source into the intake of said power means to replenish operating fluid lost from the system, said

last mentioned means operating in response to a predetermined reduction in fluid level in said collecting means.

4. In a fluid operated pump system, the combination of: a fluid operated pump in a well and adapted to be actuated by the delivery thereto of operating fluid under pressure; a production tubing extending downwardly in said well so as to receive pumped well fluid from said pump and to convey it upwardly; a power tubing extending downwardly in said well and connected to said pump and including a pair of tubing members, one of said tubing members being adapted to convey said operating fluid under pressure downwardly to said pump and the other of said tubing members being adapted to convey spent operating fluid upwardly therethrough from said pump; power means for supplying said operating fluid under pressure to said one of said tubing members; collecting means connected to said other of said tubing members and adapted to receive therefrom spent operating fluid, said collecting means being also connected to said power means so as to supply operating fluid thereto; a source of additional operating fluid; and means for supplying additional operating fluid from said source to said power means when the total volume of said operating fluid in said system decreases to a predetermined minimum.

5. In a fluid operated pump system, the combination of: a fluid operated well pump in a well and adapted to be actuated by the delivery thereto of operating fluid under pressure; a production tubing extending downwardly in said well so as to receive pumped well fluid from said well pump and to convey it upwardly; a power tubing extending downwardly in said well and connected to said well pump and including a pair of tubing members, one of said tubing members being adapted to convey said operating fluid under pressure downwardly to said well pump and the other of said tubing members being adapted to convey spent operating fluid upwardly therethrough from said well pump; a replenishing-fluid source; and a surface pump at the surface of the ground having an intake connected to said other tubing member so as to receive spent operating fluid therefrom, and having an outlet connected to said one tubing member so as to convey said operating fluid therethrough under pressure, said surface pump producing unidirectional flow from said intake to said outlet, and said surface pump including auxiliary pumping means having an intake connected to said replenishing-fluid source.

6. In a fluid operated pump system, the combination of: a fluid operated well pump in a well and adapted to be actuated by the delivery thereto of operating fluid under pressure; a production tubing extending downwardly in said well so as to receive pumped well fluid from said well pump and to convey it upwardly; a power tubing extending downwardly in said well and connected to said well pump and including a pair of tubing members, one of said tubing members being adapted to convey said operating fluid under pressure downwardly to said well pump and the other of said tubing members being adapted to convey spent operating fluid upwardly therethrough from said well pump; a surface pump at the surface of the ground having an intake, and having an outlet connected to said one tubing member so as to convey said operating fluid therethrough under pressure; a fluid collecting tank between and connected to said other tubing member and said intake and adapted to collect spent operating fluid discharged thereinto from said other tubing member and to supply such spent operating fluid to said intake under pressure; a source of additional operating fluid; auxiliary pumping means adapted to convey additional operating fluid from said source to said intake to replenish operating fluid lost from said tubing members; and means for so actuating said auxiliary pumping means in response to a predetermined decrease in the volume of spent operating fluid in said tank.

7. In a fluid operated pump for connection to a double walled tubing providing an inner tubing passage and an outer, annular tubing passage, one of said tubing passages being adapted to convey operating fluid under pressure and the other of said tubing passages being adapted to convey spent operating fluid, the combination of: fluid operated pumping means adapted to be actuated by the delivery thereto of operating fluid under pressure; and an inlet member connected to the upper end of said pumping means and having a first longitudinal inlet-member passage for conveying said operating fluid under pressure to said pumping means, and having a second longitudinal inlet-member passage for conveying spent operating fluid from said pumping means, both of said inlet-member passages communicating with the upper end of said inlet member, and having a seat at the upper end thereof adapted to be engaged in fluid-tight relation by said double walled tubing with said one tubing passage in fluid communication with said first inlet-member passage, and with said other tubing passage in fluid communication with said second-inlet member passage.

8. In a fluid-operated pump system, the combination of: a fluid-operated pump having an inlet for operating fluid under pressure and having an outlet for spent operating fluid; a reservoir communicating with said outlet of said fluid-operated pump; pumping means having an outlet communicating with said inlet of said fluid-operated pump and having a main inlet communicating with said reservoir, said pumping means also having an auxiliary inlet; a source of operating fluid communicating with said auxiliary inlet; valve means interposed between said source and said auxiliary inlet; and means responsive to a predetermined reduction in fluid level in said reservoir for actuating said valve means.

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